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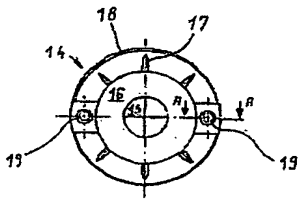
(54) Cutting Tool

(57) The invention concerns a cutting tool with a tool holder having a least one recess (11) for an exchangeable cutting insert (14). The recess exhibits a seat-bearing surface (112) matching the geometry of the cutting insert, and at least one lateral bearing surface (111) in the shape of a cylinder or a truncated cone segment, with the cutting insert (14) and the recess exhibiting indexing devices (13, 19; 22, 23; 24 to 32) allowing the exact positioning and alignment of the cutting insert in relation to the tool holder.



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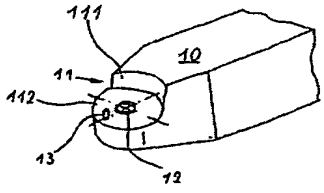

Description

The invention concerns a cutting with a tool holder having at least one recess for an exchangeable tool holder, with the recess exhibiting a seat-engaging surface matching the geometry of the cutting insert, and at least one cylindrical or conical lateral bearing surface.

Tool holders with exchangeable cutting inserts have the advantage that the actual tool can be replaced after having worn down, thus preventing extended down times as well as high costs that occur when non-wearing parts (like the tool holder) have to be replaced in conjunction with the worn part. Further advantages were also provided by the so-called indexable insert, which, after a cutting tip or cutting edge had worn down could be rotated in the insert seat of the tool holder in order to use a next, previously not used cutting edge. Indexable inserts are known in practically all cutting processes like turning, milling, reaming, piercing, turn-broaching, or turn-turn-broaching or similar variations. To the extent as the cutting inserts are not already inevitably aligned due to their external geometry, to which the seat of the cutting insert is matched, for example, in the case of triangular, rectangular or hexagonal cutting inserts, the cutting inserts must be adjusted accordingly. This applies in particular to cutting inserts with chip-forming elements on the cutting face that are aligned in respect to the cutting direction. When the actual cutting angle doesn't match the desired optimum cutting angle in relation to the chip-forming elements, the result may be a partial ineffectiveness of the chip-forming elements or the increased wearing of these parts. The same applies in regard to the geometries of other cutting faces, flanks or cutting edges, when their geometries require a special alignment of the indexing insert in regard to the workpiece.

On such cutting inserts, with either a circular outline (as seen from the top) or where the bearing surface is in the shape of circle segments, the cutting insert must be checked after each readjustment to make sure that the setting meets the adjustment requirements.

It is the objective of this invention to advance the development of a cutting tool as mentioned at the beginning of this document in such fashion that said tool would allow the exact adjustment of the cutting inserts in a simple way and without extensive constructive efforts.

The cutting tool described in this invention solves this problem in accordance with claim 1, the technical innovation of which consists in the fact that the cutting insert and the recess exhibit a set of indexing devices, the alignment of which predetermines the position of the cutting insert in relation to the holder. The indexing devices can be of any geometrical shape allowing the positioning of the cutting insert at a certain direction in relation to the tool holder receptacle. In a preferable embodiment, the indexing devices are interlocking indentations and elevations, of which special embodiments being those of a bolt, a pin or a universal ball joint opposite corresponding recesses, grooves or bore holes. In practice, the manufacturing of such fixing agents does not require great effort since, for example, indentations in the base as well as other chip-forming elements can be inserted directly during the powder-metallurgical pressing of the sintered body. The same applies to the manufacture of tool holders with bolts, ball joints or other shapes being arranged inside the seat-engaging surface or lateral bearing surface. The indexing devices are always composed of a positive part and a negative part (male-female), which interlock in such fashion that only one or multiple predetermined positions of the cutting insert in relation to the tool holder recess are possible.

In another embodiment of the invention, the indexing device can in addition be designed as a fixing and anti-twist device, for example, by being able to absorb cutting forces or additional torque. The indexing devices can be mounted either in the cylinder-segment type lateral wall of the tool holder or in the base or in both parts. The same applies to the corresponding indexing center parts of the cutting insert. This makes it possible to use one and the same tool holder receptacle for different types of cutting inserts, where one type exhibits indexing devices in the lateral surface (tool flank), while the other type has the according indexing devices in the bottom, in this case in the form of elevations.

In a preferred embodiment, free spaces in the form of a clearance will be present between the indentations and the elevations, so that an overdetermination of the position of the cutting insert in relation to the seat of the cutting insert inside the tool holder will be avoided, which in the worst case may lead to a seizure. This clearance should preferably be 0.1 mm to 0.2 mm on each side.

In another embodiment of the invention, the indexing devices are shaped polygonally asymmetrically, so that they are bitotal in regard to the type of cutting insert.

In order to provide the operator with easy control over the correct positioning of the cutting inserts in the recess of the tool holder, the indentations in the transition to the base or lateral surface of the cutting insert or the applicable corresponding surfaces of the tool holder are designed with sharp edges. The passing of a "corner" or a sharp edge can be easier detected than the passing of a "gentle transition". Also conceivable are indexing devices combining bolts and universal ball joints or similar variations, as long as the tolerances required for the clearance permit the adequate orientation of the cutting inserts in reference to the plate fit.

If in special cases, where a backing plate between the cutting insert and the seat-engaging surface in the tool holder is used, the backing plate (instead of the seat-engaging surface of the tool holder) will be equipped with the indexing devices that correspond to the matching indexing devices of the cutting insert's footprint.

In a further embodiment of the invention, parts of the indexing devices extend through the backing plate, or the backing plate itself is indexed in relation to the seat-engaging surface in the tool holder.

Embodiments of the invention are shown in the following drawings. It is shown in

Fig. 1 a partial view of a tool holder with recess for a cutting insert,

Fig. 2a a top view of a circular cutting insert on the footprint, and

Fig. 2b a cross-section along the A-A line,

Fig. 3 a cross-section along an A-A line of the cutting insert per Fig. 2a, inserted into a recess of a tool holder as shown in Fig. 1,

Fig. 4 a circular cutting insert with indexing devices in the lateral (cylinder barrel) surfaces,

Fig. 5 a tool holder with inserted cutting insert in reference to different cutting forces,

Fig. 6a to i different options for indexing devices,

Fig. 7 a to d top view of differently shaped cutting inserts allowing indexing, and

Fig. 7e to g cross-sections of the cutting inserts as shown in Fig. 7a to d.

Fig. 1 shows a tool holder 10 with a recess 11, which is terminated by a cylinder-shaped or truncated-cone-shaped sidewall 111 and a seat-engaging surface 112. As is known from the state of the art, the recess 11 is designed as a cutting insert seat, and its geometry is matched to the cutting insert it will hold. Also known is a tapped mounting hole 12 for a clamping screw extending through a cutting plate. According to the invention, the seat-engaging surface 112 has a perpendicularly projecting bolt 13 comprising the (male) part of the indexing device.

A cutting insert for the recess 11 per Fig. 1 can be seen in Fig. 2a. This cutting insert 14 has a circular shape, a mounting hole 15 in the center, and a plateau 16 with individual chip-forming elements 17 pointing to the cutting edge. Following the cutting edge may be a bevel 18 or a chip-forming groove or similar feature.

The innovation of this cutting insert 14 is that it is equipped with synclinal recesses 19 on opposite sides, as shown in the cross-sectional view in Fig. 2b. The recess 19 may be a tapped blind hole, or rectangular, rounded, trapezoid or, as shown here, curved with an aperture angle α. The depth H of the recess 19 is greater than the height of the bolt 13, insofar as it projects from the surface 112.

The method of indexing can be obtained from Fig. 3, in particular, that the height of the bolt 13 must be less than the depth of the recess 12. Between the bolt 13 and the wall of the recess 12, a distance, i.e. a clearance 20 of up to 2/10 mm will be kept. This prevents overdetermination. In place of the bolt 13, another option is an elevation, matching the outline of the recess 19, e.g. in the form of a universal ball joint or a rotation-ellipsoid shape or other three-dimensional conic sections. Another option would be for the interlocking elevations and indentations to be designed in the way of a key and lock system to function as additional retaining elements. When indexing bolts are used, the number of the recesses 19 in the cutting insert depends on how often this cutting insert shall be rotated by a specific angle. In the presented case exhibiting two recesses 19, the cutting insert can only be rotated once, since all other angle positions are locked.

Another indexing option, i.e. via the lateral surface (tool flank) 21 of a cutting element 14 is shown in Fig. 4. Identical parts of this cutting element are indicated with the identical reference marks as in Fig. 2a. In the lateral surface, at a distance to the cutting edge, the cutting insert 14 has saw-tooth type indentations 22, which together with a bolt 23 create the indexing.

Fig. 5 shows the occurring cutting forces F1 to F3, and how these forces are compensated for by the counter forces G1 to G3. In this case, the indexings 13/19 may act as an abutment, especially for forces F1 and F3.

Fig. 6 shows a selection of possible index options. The indexing parts per Fig. 6a to e are all located in the lateral surface of the shown circular cutting insert. The indexing devices may be four universal ball joints as elevated parts 24 or respective recesses 25 corresponding to matching indentations or raised parts in the lateral surface 111 (see Fig. 1). In an embodiment per Fig. 6c (exaggerated for clarification purposes), smooth bevels 26 have been created, which (in contrast to indexes 24 and 25) may also extend all the way to the cutting edge. The cutting insert per Fig. 6d has four tapped blind holes 27, while the cutting insert per Fig. 6e has a bolt 28.

Indexing parts in the footprint of the cutting insert, possibly in both faces of indexable inserts, are shown in Fig. 6f to 6i. The cutting insert may, for example, contain a diagonally extending indentation 29 or four cross-shaped and raised ridges 30 or three or more raised universal ball joints 31,32 corresponding to matching ridges, grooves or dome-shaped indentations. As shown in Fig. 6i, the indentation of the cutting insert may also have a polygonal, completely unsymmetrical shape 32, which in addition may serve as a retaining element in regard to a corresponding socket in the support plate. All methods of corresponding indexing are possible in the seat-engaging surface of the tool holder 10 as well as in a potentially installed support plate, which itself may be indexed in reference to the contact surface.

Fig. 7 shows some of the cutting plates, for which this invention is of importance. According to Fig. 7a, the individual cutting inserts are circular, or according to Fig. 7b and 7c have seat-engaging surfaces 33 in the shape of circle segments (as seen from the top), while the respective cutting edges on the opposite side may have all types of different shapes.

Fig. 7e to g show cross-sections of known cutting plates, indicating the face geometry, especially the cutting cavities 34 as well as the plateaus 35 and chamfered tool flanks 36. Fig. 7f shows an indexable insert both sides of which may be used for indexing.

Patent Claims

1. Cutting tool with at least one recess (1) for an exchangeable cutting insert (14) in a tool holder (10), with the recess (11) having a seat-engaging surface (112) being matched to the geometry of the cutting insert,

and at least one cylinder or truncated-cone-shaped or cone-shaped lateral bearing surface (111), **characterized by** the cutting insert (14) and the recess (11) exhibiting indexing devices (13, 19; 22,23; 24 to 32) allowing a predetermined position of the cutting insert (14) in relation to the tool holder (10) due to their alignment.

2. Cutting tool according to claim 1, wherein the indexing devices (13,19) are comprised of interlocking indentations (19) and elevations (13).

3. Cutting tool according to claim 1, wherein the elevations (13) are comprised of a bolt, a pin or a universal ball joint, and the indentations being a tapped blind hole or a milled recess (19).

4. Cutting tool according to one of the claims 1 to 3, wherein the indexing device (13, 19; 22, 23; 24 to 32) is also designed to function as a retaining and anti-twisting device.

5. Cutting tool according to one of the claims 1 to 4 wherein the cutting insert contains the indexing devices on the lateral surface (33) facing the seat-engaging surface (111) of the tool holder (10), and/or on its base.

6. Cutting tool according to one of the claims 1 to 5, wherein a clearance (20) exists between the indentation (19) and the elevation (13) of an indexing device.

7. Cutting tool according to claim 6, wherein the clearance (20) on each side is 0.1 mm to 0.2 mm.

8. Cutting tool according to one of the claims 1 to 7, wherein the indexing devices (32) are comprised of polygonal, unsymmetrical shapes.

9. Cutting tool according to one of the claims 1 to 8, wherein the indentations in the transition to the base or the lateral surface of the cutting insert are designed with sharp edges.

10. Cutting tool according to one of the claims 1 to 9, wherein a backing plate is located between the cutting insert (14) and the bearing surface (112) in the tool holder exhibiting parts of the indexing devices (13,19; 22,23; 24 to 32) corresponding with parts in the base of the cutting insert.

11. Cutting tool according to claim 10, wherein the parts of the indexing devices extend through the backing plate, or wherein the backing plate itself is indexed in relation to the bearing surface (112) in the tool holder (10).

Attached: 6 page(s) of drawings

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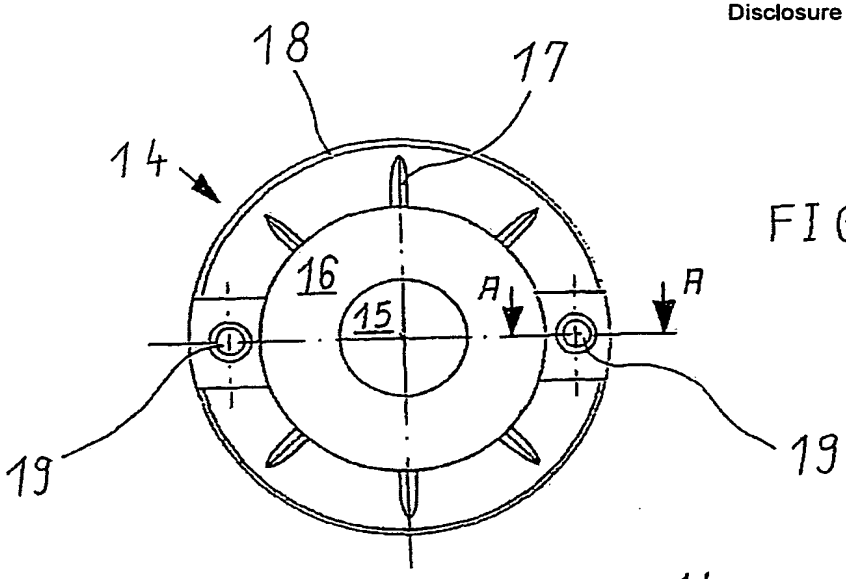

FIG. 2 a

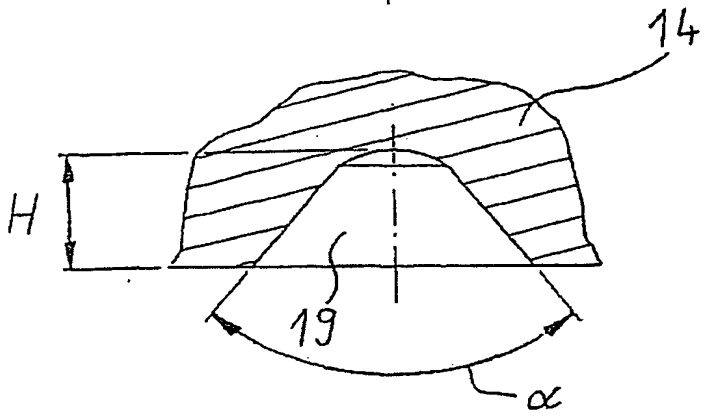

FIG. 2 b

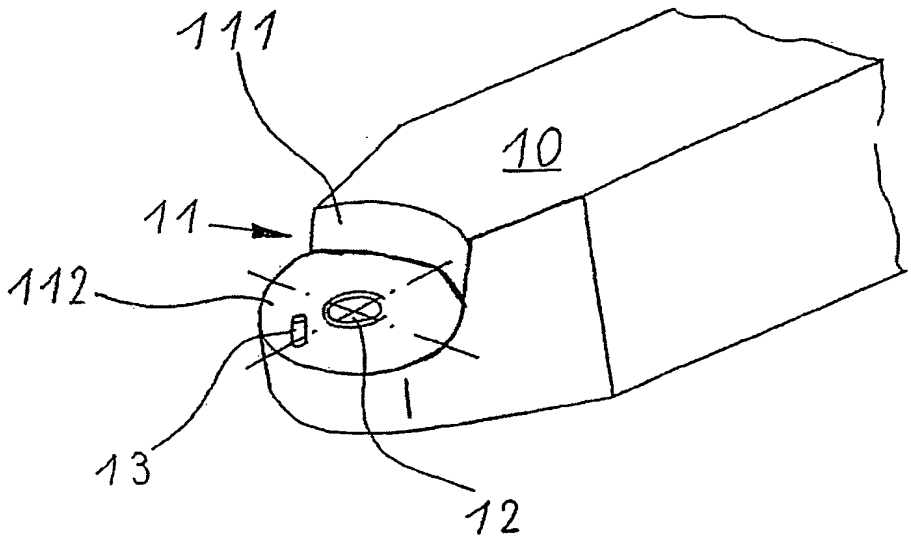

FIG. 1 X

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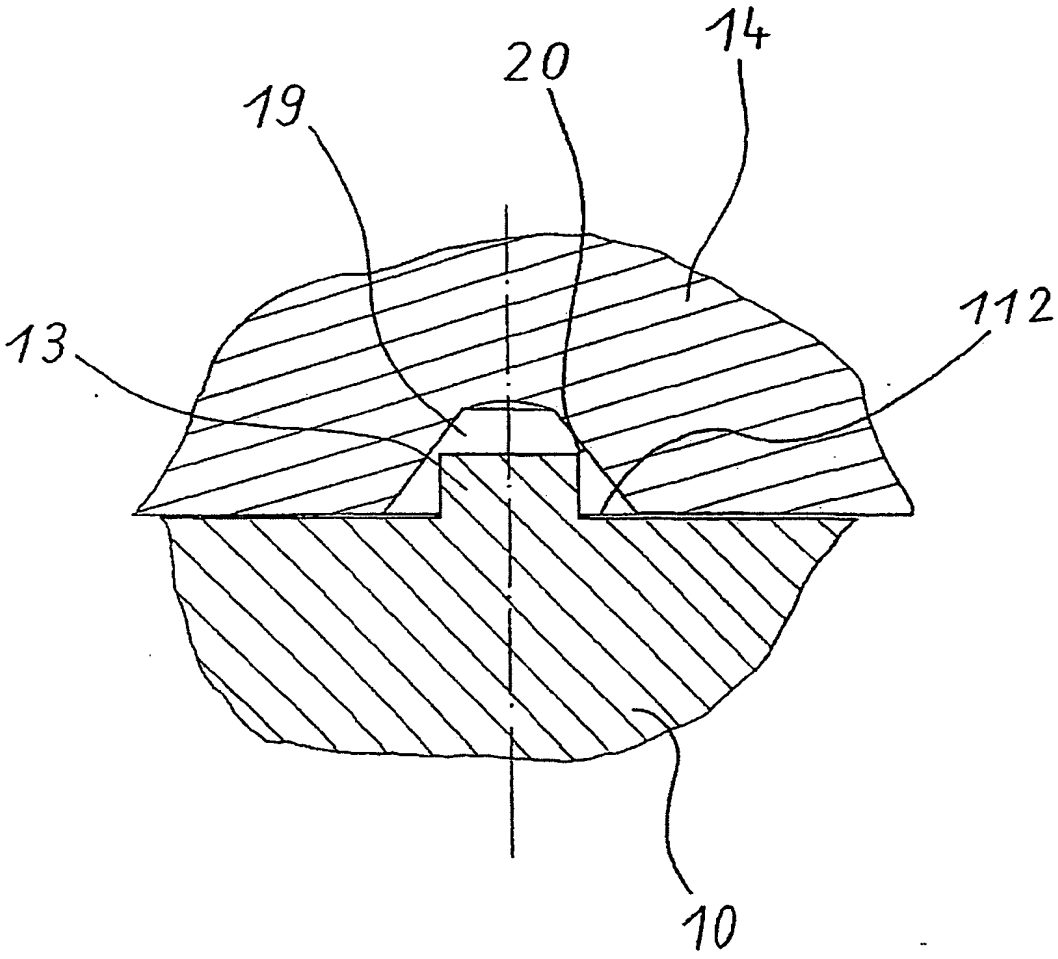

FIG. 3

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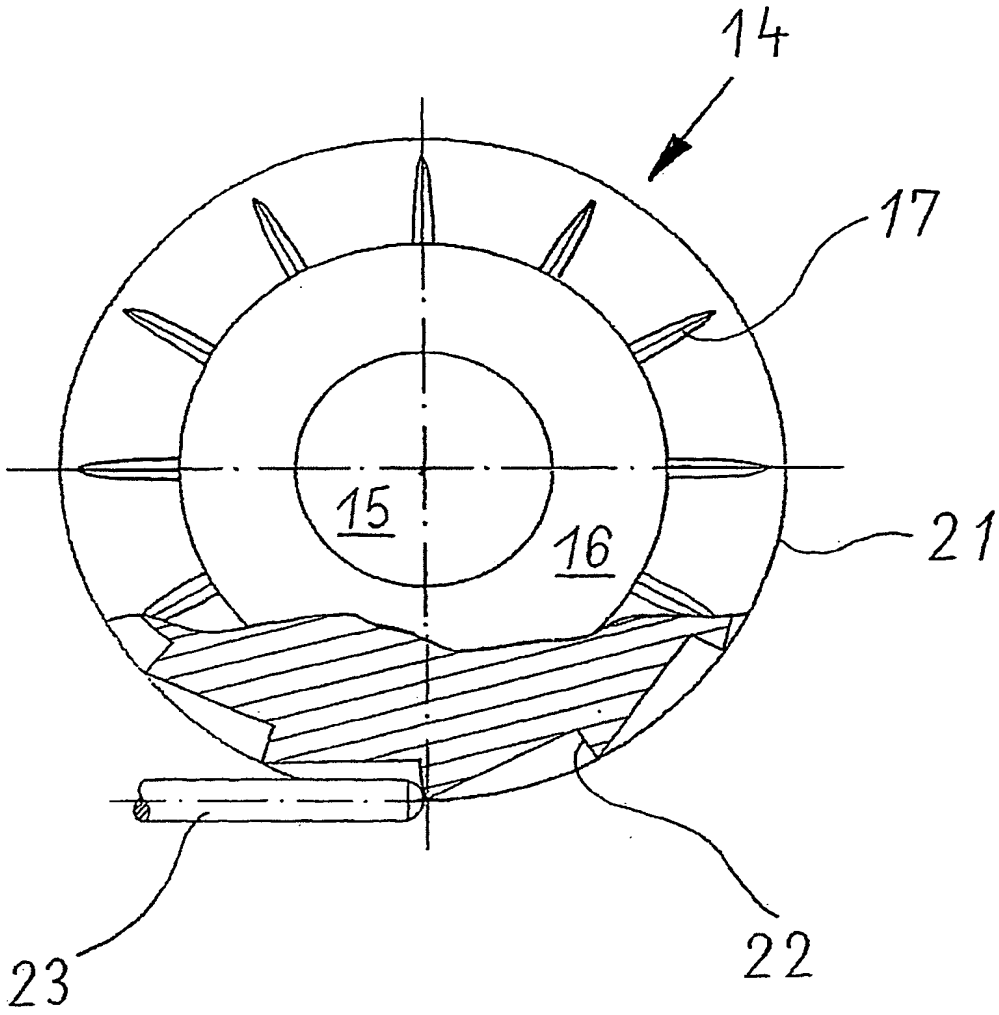

FIG. 4

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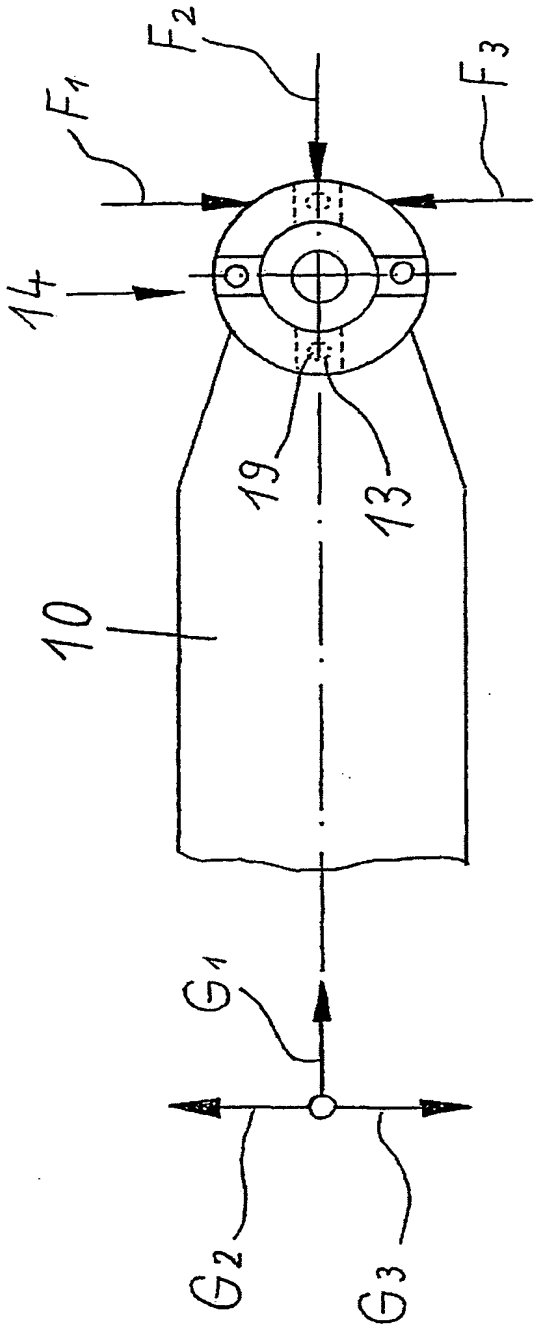

FIG. 5

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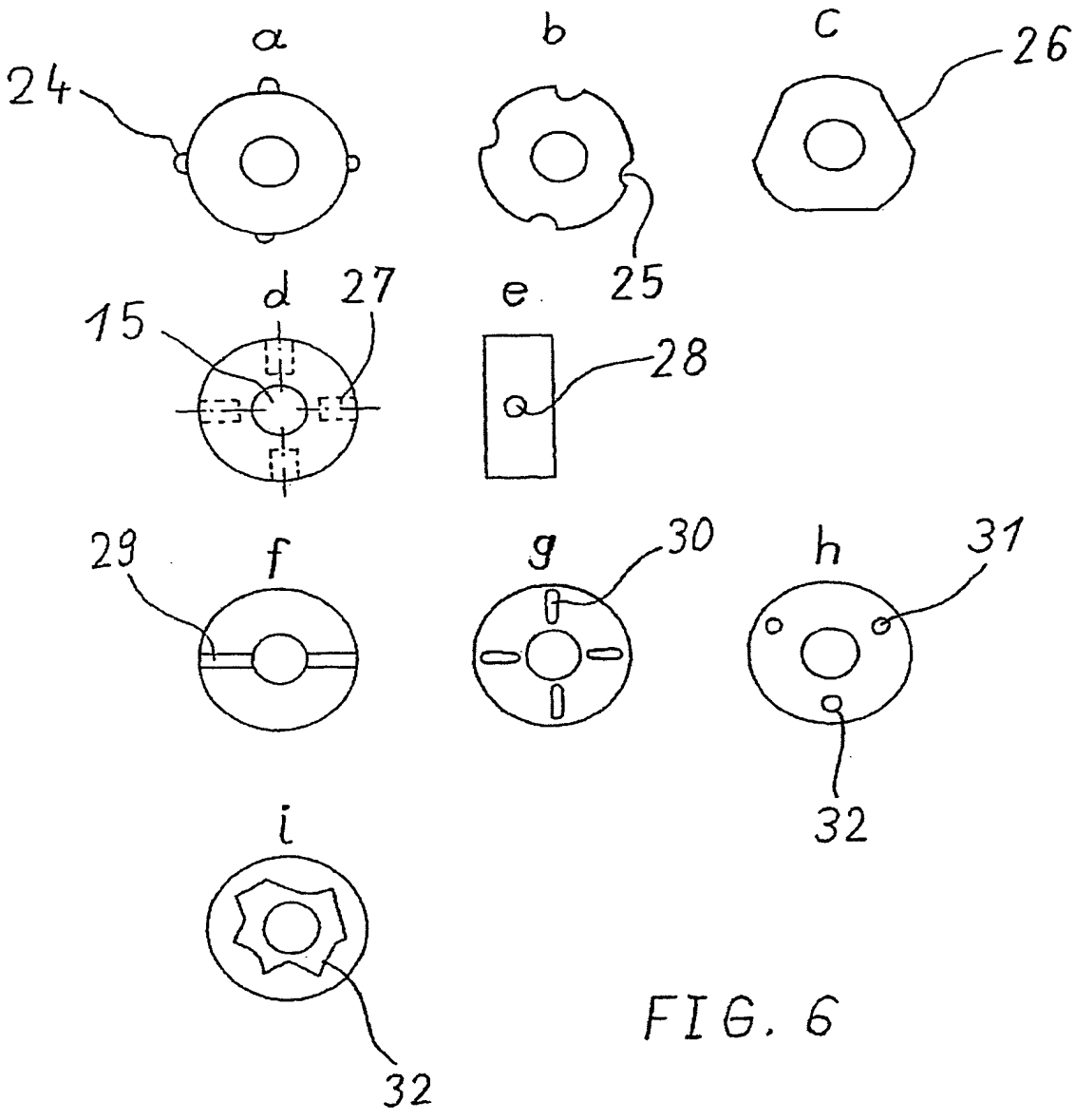

FIG. 6

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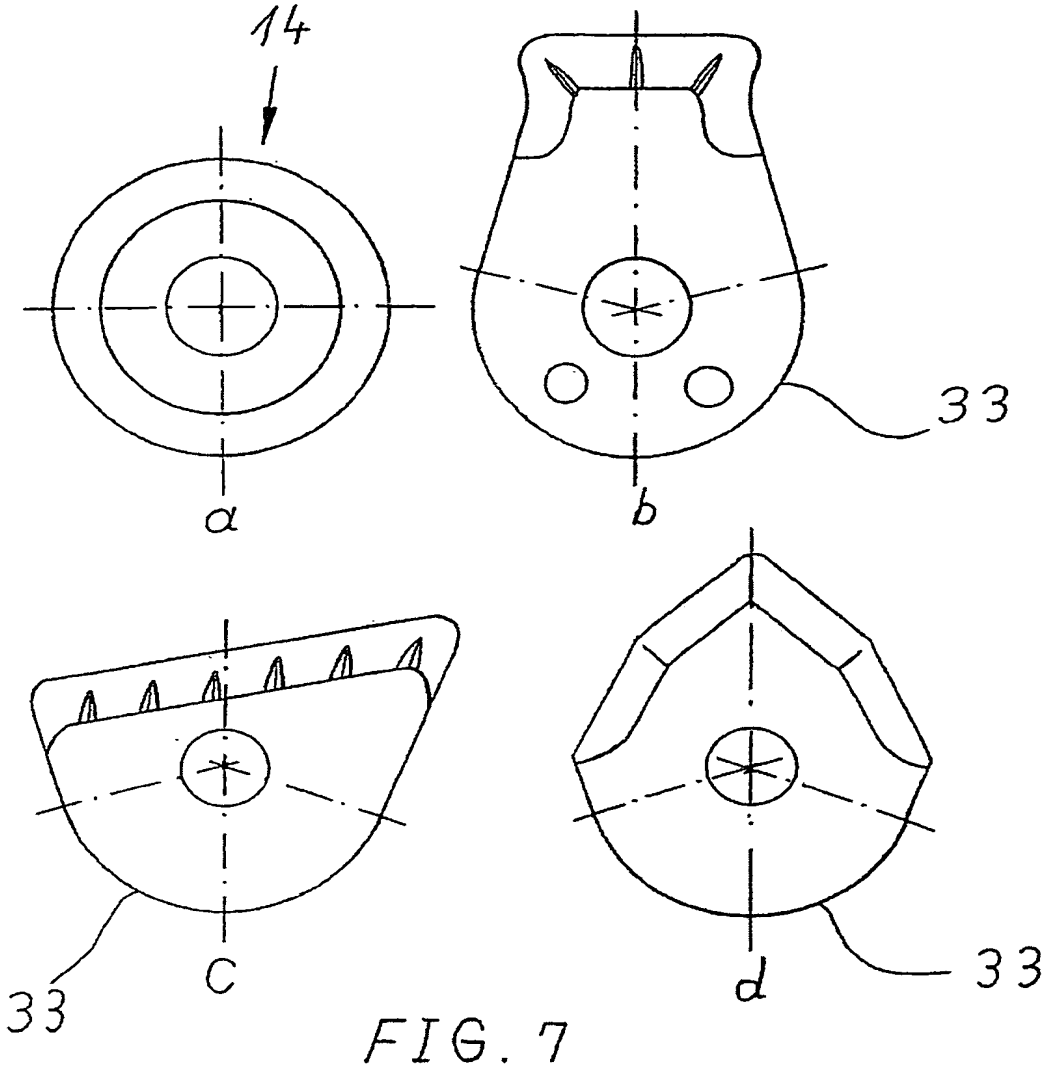
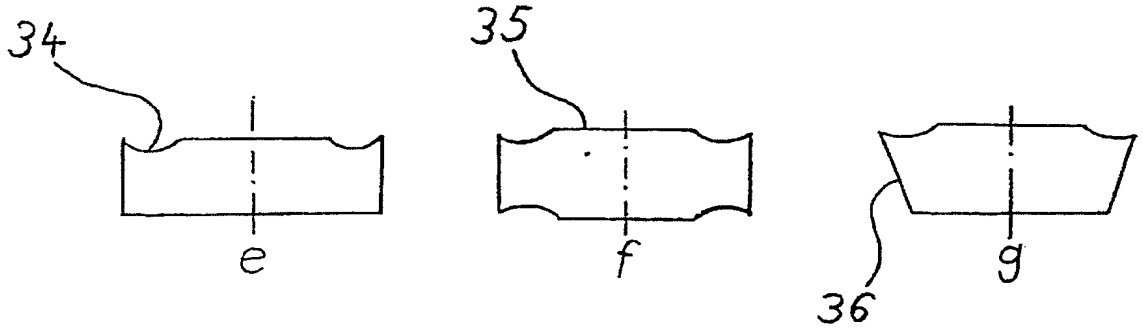


FIG. 7



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September 12, 2005

I, Angela Christie, hereby certify that I am competent in both English and German languages. I further certify that under penalty of perjury translation of the aforementioned patent:

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from the German language into the English language is accurate and correct to the best of my knowledge and proficiency.

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